2011 GSS APBI Briefing:
Hit and Kill Avoidance Organization

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

TARDEC GSS Industry Day
**Hit and Kill Avoidance**
14 June 2011

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14. ABSTRACT

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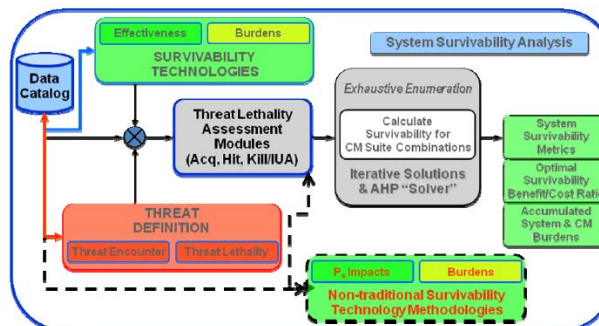| 16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
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Hit and Kill Avoidance Overview

Hit Avoidance/Active Protection

UDRI

Air Gun
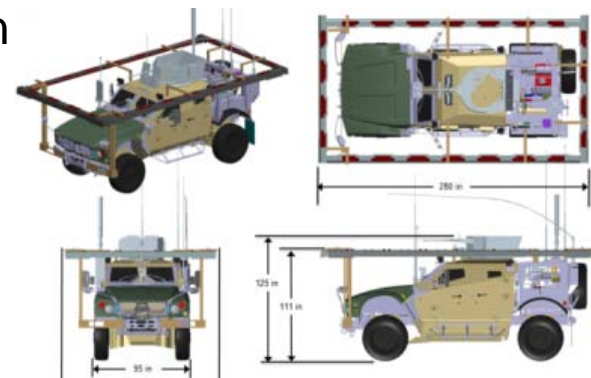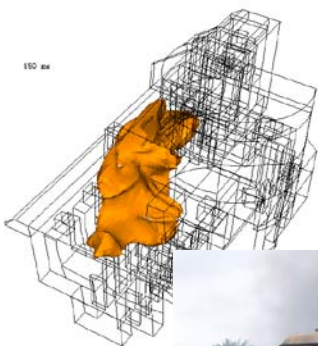
Fire Protection

System Optimization

Laser Protection
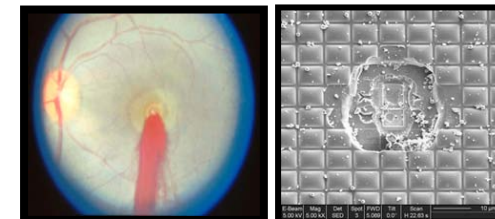
Program Name	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18
Hit Avoidance (HA) Technologies								
RPG Active Protection (RAP)	■	■	■	■				
Mature an APS for unitary RPG defeat. Demonstrate integrated ATGM defeat system. Development of passive system integration kits and technology advancements.								
Enhanced RPG Active Protection (ERAP)			■	■	■	■	■	
Utilizing open arch, mature APS components for 360° hemispherical tandem RPG/ATGM defeat. Includes passive systems dev and tech advan, next gen countermeasure.								
Kinetic Energy Active Protection System (KE APS) Effort	■	■	■					
Provide capability to defeat Tank-fired Kinetic Energy (KE) Long Rod Threats with guided interceptor.								
Vertical-launch Architecture LOng Range (VALOR) APS				■	■	■		
Guided interceptor integration into vertical launch system architecture, that includes an alternate fuzing for ATGM defeat.								
Kill Avoidance Technologies								
Common AFES System Development	■	■	■	■				
Development of a set of standards, requirements and components to support a common AFES system for tactical and combat ground platforms.								
Advanced Fire Suppression Technologies					■	■	■	■
Development, integration, test and research on fire protection technologies (e.g. agents, distribution, ammo protection, fuel tank enhancements, battery suppression, etc.).								
Vision Protection from Lasers (VPL)	■	■	■	■				
Fire control optics to incorporate wavelength-agile laser protection.								
Advanced Directed Energy Protection – Cameras & Eyes			■	■	■			
Establish laser damage thresholds for sensors.								
Short-Pulse & High Energy Laser Protection Research						■	■	■
Test and document laser protection performance of various materials against the emerging technologies of both SPHP laser systems.								
Vehicle Optimization								
Threat Oriented Survivability Optimization (TOSOM)	■	■	■	■	■	■	■	■
Software code to represent survivability technologies (signatures, hit avoidance, armor, blast, kill avoidance) for the assessment of specific technology and/or technology suites.								
Demonstrator For Novel Design (DFND)	■	■	■					
Effort leveraging motorsports unique tools, processes, and innovative technology ideas to enhance Force Protection, Vehicle Survivability, and Mobility.								

Active Protection Programs

Purpose:

- *Technology development and maturation for RPG hard-kill defeat and ATGM soft-kill defeat.*
- *Iterative build-up of a Hit Avoidance Development and Integration Lab (HADIL) with capability and tool enhancements to support in-house test and validation of components.*

Requirements:

- *Efforts are planned and synchronized in order to meet customer requirements now and in the future.*
- *The RAP program will develop, build, and test toward requirements derived from TRADOC, PM Stryker, and PM MRAP.*

Products:

- *RAP Program: Hard-kill APS, using a plug-n-play open architecture approach for RPG threats*
- *FOGHAT: Low-cost, light-weight integrated ATGM softkill defeat system including threat detection sensor, fire-control processor and countermeasure.*
- *HADIL: Hardware in-the-loop test capability to verify TRL compliance*

Active Protection Program Schedule

Program / Technology / Capability:	FY12	FY13	FY14	FY15	FY16	FY17	FY18
RPG Active Protection (RAP)	◇━━━━━━━━━━━━━━━6						
Mature / modify countermeasure, sensors, processors/software (systems) to requirements							
APS component level test and verification							
Design and integration of APS onto platform							
APS system level test and verification							
False Opt. Guidance HA Tech (FOGHAT)	━━━━━━━━━━━━━━━━━━━━━━━━━━━━6						
CM / Sensor / C&C Integration							
Compliance Hardening							
Defeat mechanism enhancements							
Next gen countermeasure, integrate, and test							
Hit Avoidance Devlpmt. & Int. Lab (HADIL)	━━━━━━━━━━━━━━━━━━━━━━━━━━━━━▶						
Modular lab foundation, architecture development, and integration		▬					
Air Cannon install and operational assessment		▬					
Common Display design tools devlp. and intg.			▬				
Testing and evaluation of HA components	━━━━━━━━━━━━━━━━━━━━━━━━━━━━━▶						

RAP Program utilizes AP compliance plan to verify system against requirements

◇ Technology Readiness Level (TRL)

AP Key Technical Components

RPG Active Protection (RAP) Program

Key Program Component: Leveraging existing APS to show compliance to PM requirements through a test and verification program.

Issue(s): PM requirements and existing APS capabilities delineate a technology gap; Need significant reduction in delta between capability and requirements

Plan to Approach: Partnership between Gov't and Contractor for system modification and development to TRADOC/PM developed requirements; Government test and verification

False Optical Guidance Hit Avoidance Technology (FOGHAT) Program

Key Program Component: Demo low-cost softkill ATGM defeat system including; countermeasure, warning sensor and fire-control. Future growth to include additional threats.

Issue(s): Identifying the required defeat mechanism for ATGMs

Plan to Approach: Coordinated effort between RDECOM and industry to mature and integrate existing tech to demo the capability to defeat an ATGM in an end-to-end scenario.

Hit Avoidance Development & Integration Lab (HADIL)

Technology development and evaluation. Capabilities will include M&S, HW in the loop testing / emulation, SW validation, physical test, vehicle integration, and integration SW validation.

AP Industry Partnership Outlook

RPG Active Protection (RAP) Program
- Will utilize the TARDEC Omnibus Contract
- RAP RFI with initial draft requirements was released in January 2011

False Optical Guidance Hit Avoidance Technology (FOGHAT) Program
- Integration of existing Multi-Function Countermeasure components (leveraged from U.S. Army Integrated Army APS Program) with sensor and fire-control
- Development of defeat mechanisms for ATGMs
- Next generation sensor, fire-control and countermeasure

Hit Avoidance Development and Integration Lab (HADIL)
- HLA/DIS compliant simulation, processor engagement load cases and man machine interface
- System evaluation and emulation with stressing cases
- Threat characterization
- Physical test data acquisition and analysis
- Potential CRADA partner to leverage IRAD activities.
- Physical System Integration with A-Kit Design

Program	POC
All	Steve Caito
RAP	Heather Kammer
FOGHAT	Jason Morse
HADIL	Will Norton

Common AFES Program Overview

Purpose:

- Provide emerging platforms and legacy vehicle programs with improved damage mitigation techniques to protect against fire threats.

Requirements:

- Battlefield threats have exposed fire protection capability gaps in vehicles. Efforts align with platform survivability and crew protection Warfighter Outcomes and support PM needs for more capable fire protection. Common component efforts requested by PEO GCS & CS/CSS.

Products:

- Improved fire protection for vehicles and crews.
- Common AFES components.
- Next generation materials/technologies to protect track/tires/FST, fuel, and batteries.
- M&S tools for advanced threats/technologies.
- Laboratory to investigate fire protection technologies at component and system level.

Aerojet   **Spectrex/ Amerex**   **Kidde**   **Pacific Scientific**

Com. Equip   **Fire TIL**   **Com Solution**

Fire Protection Program Schedule

Milestones	FY	10	11	12	13	14	15	16

Common AFES
- Database
- Extinguishers
- Sensors
- Control Panels

(Milestones: 5, 6, 7)

Vulnerability Reduction
- Li-ion batteries
- Fuel tanks
- Track/Tires/FST

(Milestones: 5, 6, 7)

Fire Protection TIL
- Phase I, Phase II & Phase III
- Construct Facility and Operation

Modeling and Simulation
- Fixture
- Vehicle
- Enhancements

TRL ◇

Fire Protection Key Technical Components

Common AFES

Key Program Component: Develop common components for fire suppression systems to include extinguishers, sensors, and control panels.
Issue(s): Lack of standardized requirements and equipment. Systems are tailored to each platform within their SWAP constraints.
Plan to Approach: Implement common AFES components to reduce logistics and maintenance costs.

Vulnerability Reduction

Key Program Component: Develop techniques to address vulnerabilities in emerging technologies (i.e. Li-ion batteries, Fuel tanks, Track/Tires/Fire, Smoke, and Toxicity)
Issue(s): Peacetime & combat-initiated fires are a major source of crew casualties/vehicle damage.
Plan to Approach: Utilize next generation materials and technologies for vehicle protection.

Fire Protection TIL

Key Program Component: Capabilities to develop, integrate, and evaluate vehicle/occupant fire protection.
Issue(s): Need faster and thorough evaluation of new solutions that can be integrated on weapon systems.
Plan to Approach: The facility will support integration, engineering, test and evaluation of next generation materials and technologies.
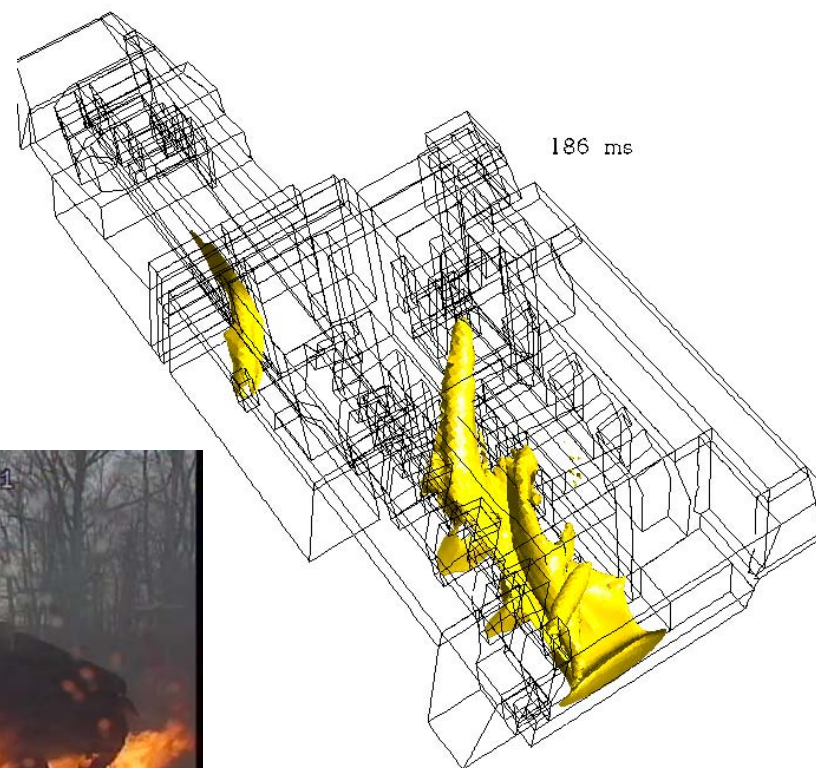
Modeling and Simulation

Key Program Component: M&S code to predict performance of emerging crew AFES.
Issue(s): Models, integration, and testing of existing and novel systems and components do not exist.
Plan to Approach: Create capability to predict fire extinguishing system perf and compare configurations.

Fire Protection POC's

Program	POC
Fire Protection Team	Steve McCormick
Fire Protection TIL	Eric Hahka

Vision Protection from Lasers Program Overview

Purpose:

- *Provide solutions protecting eyes and day-vision cameras from laser weapons*

Requirements:

- *Develop materials that limit the amount of light energy allowed to the sensor*
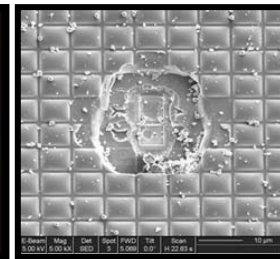- *Develop new optical system designs allowing the integration of advanced laser protection materials*

Products:

- *Designs, data and reports for applying laser protection technologies to platform optical sighting systems*
- *Designs and reports for applying laser protection technologies to unity magnification periscopes*
- *Sensor vulnerability & signature studies, designs to protect from lasers & mitigate signature*
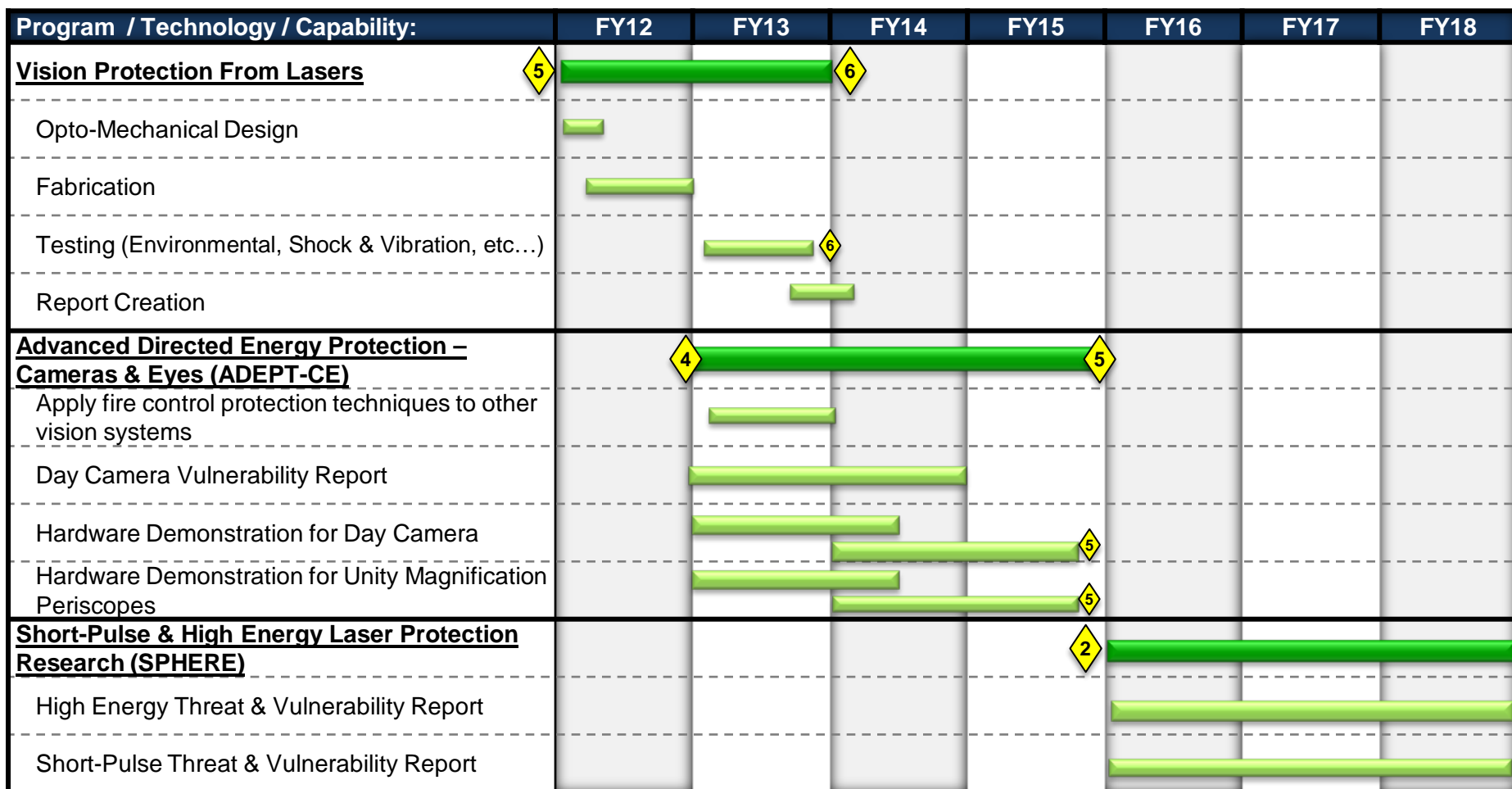
RETINAL HEMORRHAGE   CAMERA DAMAGE   CAMERA JAMMING

camera display before laser shot

camera display after laser shot

Laser Protection Program Schedule

Program / Technology / Capability:	FY12	FY13	FY14	FY15	FY16	FY17	FY18
Vision Protection From Lasers	◆5 ━━━━━━━━━━ ◆6						
Opto-Mechanical Design	▬						
Fabrication		▬▬					
Testing (Environmental, Shock & Vibration, etc…)		▬▬ ◆6					
Report Creation			▬				
Advanced Directed Energy Protection – Cameras & Eyes (ADEPT-CE)	◆4 ━━━━━━━━━━━━━━━━━━ ◆5						
Apply fire control protection techniques to other vision systems		▬▬					
Day Camera Vulnerability Report		▬▬▬▬▬					
Hardware Demonstration for Day Camera		▬▬▬	▬▬▬▬ ◆5				
Hardware Demonstration for Unity Magnification Periscopes		▬▬▬	▬▬▬▬ ◆5				
Short-Pulse & High Energy Laser Protection Research (SPHERE)				◆2 ━━━━━━━━━━━━━━━━━━ ◆4			
High Energy Threat & Vulnerability Report					▬▬▬▬▬▬▬▬▬		
Short-Pulse Threat & Vulnerability Report					▬▬▬▬▬▬▬▬▬		

◆ Technology Readiness Level (TRL)

Laser Protection Key Technical Components

Vision Protection From Lasers Program

Key Program Component: Simplified Optical Design.
Issue(s): Concepts for the integration of technologies are complex (many optical elements).
Plan to Approach: Working with optical designers and OEMs to simplify the designs while meeting protection and performance requirements.

Advanced Directed Energy Protection – Cameras & Eyes (ADEPT-CE) Program

Key Program Component: Continuous-Wave Band Blocking
Issue(s): Filters used to block certain wavelength(s) from entering an optical system. High speed insertion of filters is challenging.
Plan to Approach: Need compact integrated switching mechanisms. Collaborate for the development of fast switching technologies to replace filters and optical materials.

Short-Pulse & High Energy Laser Protection Research (SPHERE):

Key Program Component: Research short-pulse/high power laser energy on optical systems.
Issue(s): New technologies in laser fabrication may have new science to be researched.
Plan to Approach: Work with industry to perform basic research on the science around shorter pulse and higher energy lasers.

Laser Protection POC's

Future Research:
- ***Shorter Pulses***
- ***Higher Powers***

Program	POC
Laser Protection Research & Technology Integration Laboratory	Robert Goedert

TOSOM Program Overview

Purpose:

- Advanced and innovative capability to perform system level trades using a mathematical assessment of the benefits and burdens of both traditional and non-traditional survivability technologies.

Requirements:

- Need for the ability to model optimal vehicle survivability while minimizing the overall burdens.
- Leverage existing and future survivability efforts such as Hit Avoidance SIL, Long Range Active Protection System Simulation (LRAPSS), GSS Crew Protection Systems Integration Lab, Fire Suppression Efforts and Blast Mitigation
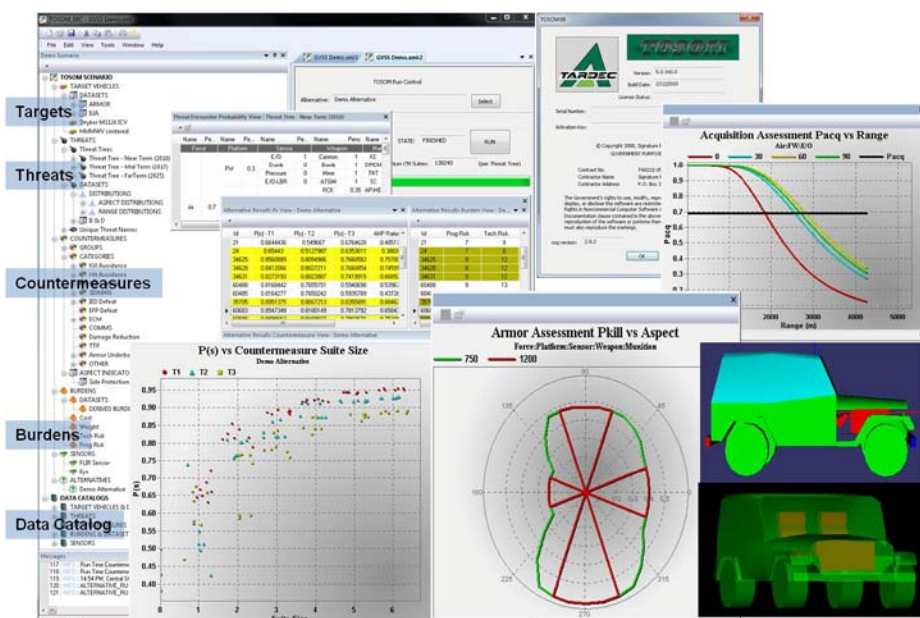
Products:

- Optimization Software
- Supporting "trade-offs" for survivability systems.
- Quantifiable survivability metrics
- Streamlining of concept definition phase
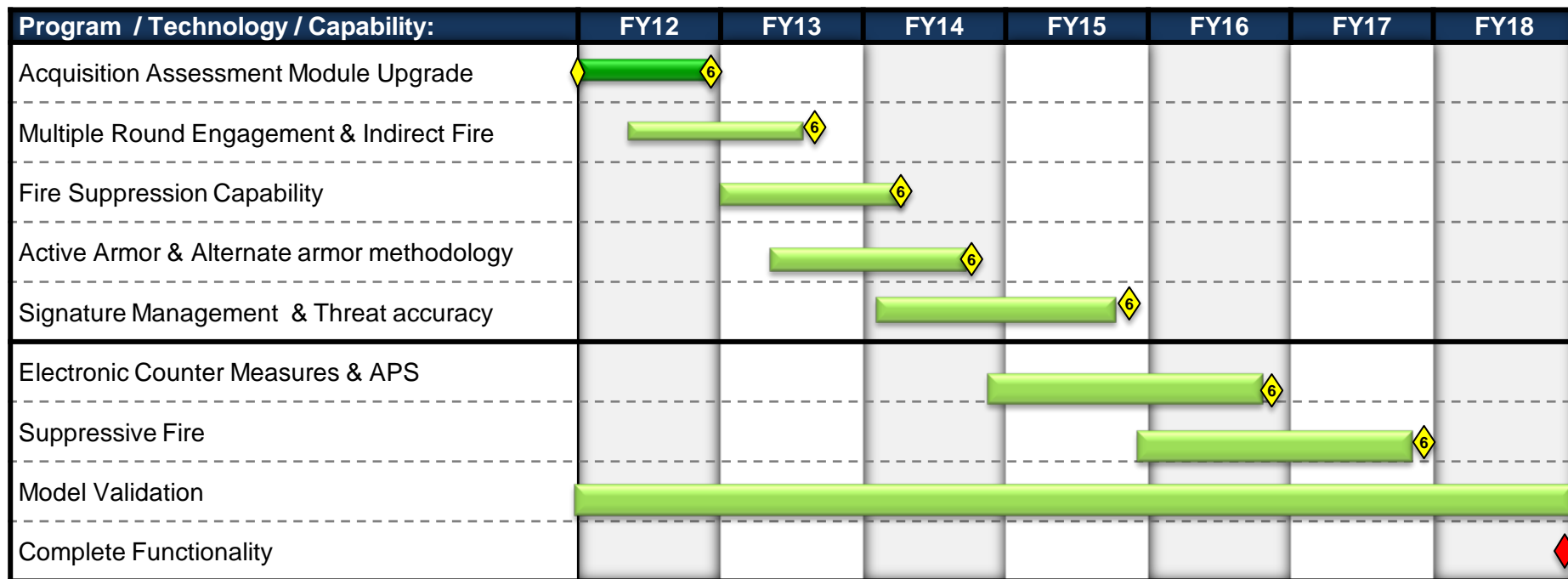- Visibility into (Acquisition/Hit/Kill) assessment data
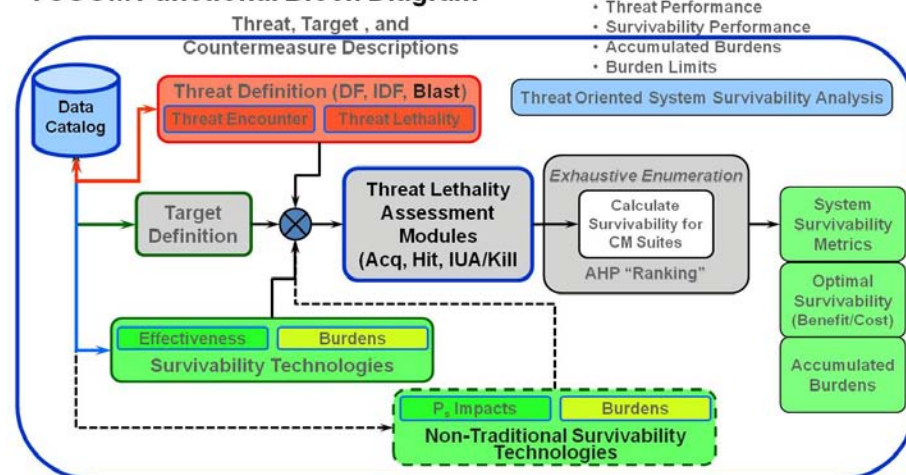
TOSOM Provides Analytical Insights Into Optimal System Survivability Solutions

TOSOM Program Schedule

Program / Technology / Capability:	FY12	FY13	FY14	FY15	FY16	FY17	FY18
Acquisition Assessment Module Upgrade	◇━━6						
Multiple Round Engagement & Indirect Fire		━━6					
Fire Suppression Capability		━━━6					
Active Armor & Alternate armor methodology		━━━6					
Signature Management & Threat accuracy			━━━6				
Electronic Counter Measures & APS				━━━━6			
Suppressive Fire					━━━━6		
Model Validation	━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━						
Complete Functionality							◆

◇ Technology Readiness Level (TRL)

TOSOM Key Technical Capabilities

- Support "*trade-offs"* for survivability systems

- Provides "*Quantifiable*" survivability metrics

- Assessment tool for "*what if*" and "*how much*" questions

- Use and inclusion of "*Accredited*" data

- Ease of problem setup and metric "*Standardization*"

- Development of metrics for definition of *"Requirements"*, *"Evaluation"* and *"Validation"*

- *Derived burdens allows assessment of Performance vs Protection vs Cost/TRL/Risk*

System Optimization & Modeling Team

➢ SOM Team has the unique expertise/experience to perform analyses in the optimization of traditional and non-traditional survivability technologies.

➢ TOSOM is a decision support tool designed to conduct survivability suite tradeoff analyses. It is a methodology for:

>   Selecting feasible solutions from a number of possible outcomes
>   Estimating the variety and magnitude of combat risks to a system
>   Providing robust, responsive "what if" analyses

➢ TOSOM services can be contracted for DOD studies and projects.

Program	POC
System Optimization & Modeling - TOSOM	Thomson David
System Optimization & Modeling - TOSOM	Daniel Hicks